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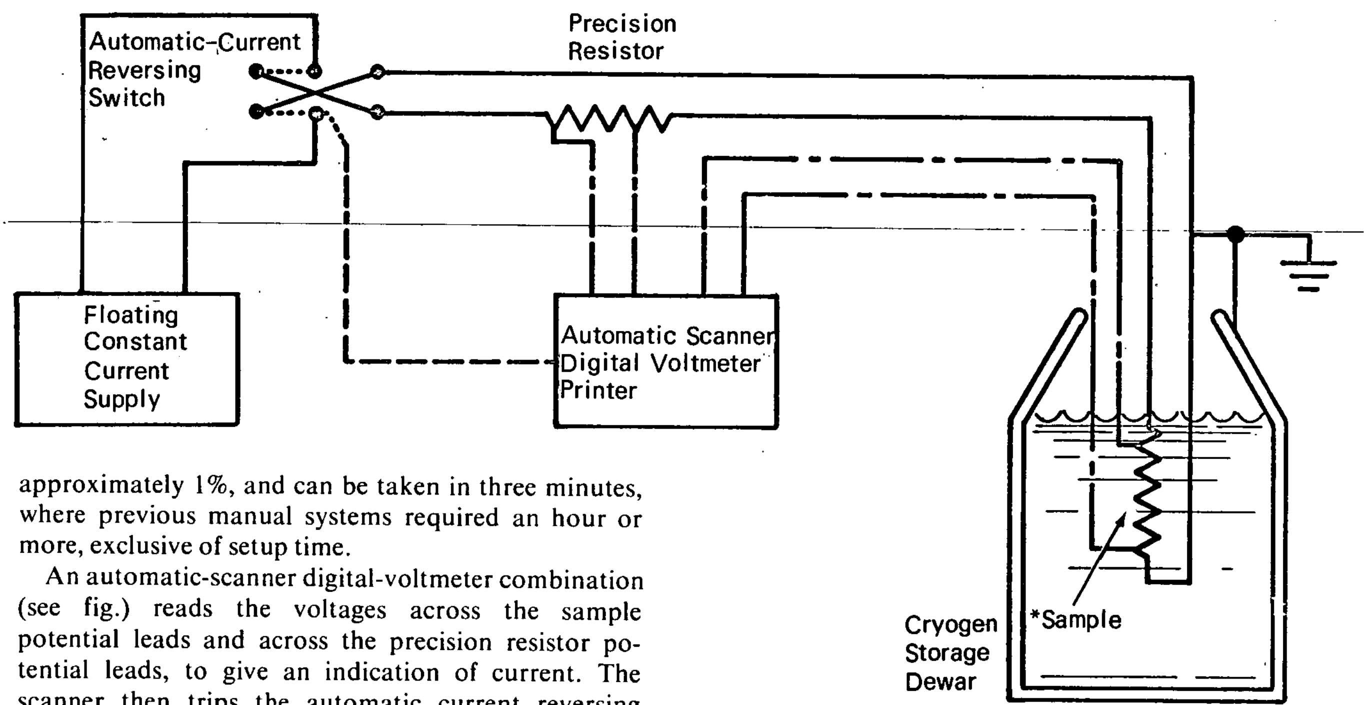
Brief 71-10104

AEC-NASA TECH BRIEF

Space Nuclear Systems Office

Metal Alloy Resistivity Measurements at Very Low Temperatures

A new, high speed, automated system accurately measures resistivity characteristics of alloys at low temperatures (to 4°K). Measurements are accurate to approximately 1%, and can be taken in three minutes, where previous manual systems required an hour or more, exclusive of setup time.



*Hold in Dip-Probe, not shown

An automatic-scanner digital-voltmeter combination (see fig.) reads the voltages across the sample potential leads and across the precision resistor potential leads, to give an indication of current. The scanner then trips the automatic current reversing switch, and repeats the sequence every 10 seconds for 19 successive readings. The averaging method thus obtained eliminates the effects of spurious thermoelectric voltages. A simple dip-probe, designed specifically for this system, is used to hold the sample in place.

The system was used to take resistivity measurements on 65 different alloys of aluminum, nickel, copper, titanium, and iron, at five different temperatures ranging from 273°K to 4°K. Eighty-one measurements were obtained in less than half a day (exclusive of setup time). Aside from providing a rich source of new data, these measurements also produced a broader base for understanding the behavior of alloys. For example, thermal conductivity can be predicted from the more easily measured electrical resistivity and Lorenz ratio for a given class of similar alloys; low temperature electrical resistivity of an alloy within a given class can be reliably predicted from a room temperature measurement; the degree of precipitation hardening can be directly correlated to electrical resistivity; and, the

(continued overleaf)

resistivity of an unknown alloy can be calculated from the specific resistivities of known alloys, if one impurity is dominant, or if the total impurity content is less than approximately 5%.

Because of its versatility, the system can be used to identify known or new materials having a constant thermal or electrical conductivity, to predict properties of new materials, to develop alloys in accordance with desired specifications, and to develop nondestructive devices for measuring precipitation hardening.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
AEC-NASA Space Nuclear Systems Office
U.S. Atomic Energy Commission
Washington, D.C. 20545
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Patent status:

No patent action is contemplated by AEC or NASA.

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